

I claim:

1. (Amended) A method of detecting fractures in a fractured zone in an Earth formation, comprising the steps of:
  - a. propagating a plurality of acoustic waves through the fractured zone so that the plurality of acoustic waves reflect off a horizon in the formation;
  - b. receiving and recording a plurality of seismic traces responsive to and representative of the acoustic waves propagating through the fractured zone wherein a first portion of the seismic traces corresponds to a first window located above the fractured zone in the formation, and a second portion of the seismic traces corresponds to a second window located below the fractured zone in the formation;
  - c. generating a first frequency spectrum associated with the first portion of the seismic traces corresponding to the first window;
  - d. generating a second frequency spectrum associated with the second portion of the seismic traces corresponding to the second window;
  - e. superimposing the first frequency spectrum onto the second frequency spectrum thereby generating a superimposed frequency spectrum and defining from the superimposed frequency spectrum a low frequency and a high frequency;
  - f. when the low frequency and the high frequency is defined, further defining from the superimposed frequency spectrum a plurality of amplitude values, the plurality of amplitude values including: an amplitude  $F_a(\text{high})$  of the first frequency spectrum at the defined high frequency, an amplitude  $F_a(\text{low})$  of the first frequency spectrum at the defined low frequency, an amplitude of the second frequency spectrum

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Fb(high) at the defined high frequency, and an amplitude Fb(low) of the second frequency spectrum at the defined low frequency;

- g. from the plurality of amplitude values, defining a  $t^*$  attribute by subtracting the natural log of the ratio of Fa(low) to Fb(low) from the natural log of the ratio of Fa(high) to Fb(high) to get a numerator and dividing the numerator by a denominator which comprises the defined high frequency less the defined low frequency;
- h. plotting the  $t^*$  attribute on a map and assigning a unique color to the  $t^*$  attribute.

5. (Amended) A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for detecting fractures in a fractured zone in an Earth formation, the method steps comprising:

- a. operating on a plurality of received and recorded seismic traces, responsive to and representative of a plurality of acoustic waves propagating through the fractured zone and reflecting off a horizon in the formation, to define a first portion of the seismic traces corresponding to a first window located above the fractured zone in the formation, and to define a second portion of the seismic traces corresponding to a second window located below the fractured zone in the formation;
- b. generating a first frequency spectrum associated with the first portion of the seismic traces corresponding to the first window;
- c. generating a second frequency spectrum associated with the second portion of the seismic traces corresponding to the second window;

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- d. superimposing the first frequency spectrum onto the second frequency spectrum thereby generating a superimposed frequency spectrum and defining from the superimposed frequency spectrum a low frequency and a high frequency;
  - e. when the low frequency and the high frequency are defined, further defining from the superimposed frequency spectrum a plurality of amplitude values, including an amplitude  $F_a(\text{high})$  of the first frequency spectrum at the defined high frequency, an amplitude  $F_a(\text{low})$  of the first frequency spectrum at the defined low frequency, an amplitude of the second frequency spectrum  $F_b(\text{high})$  at the defined high frequency, and an amplitude  $F_b(\text{low})$  of the second frequency spectrum at the defined low frequency;
  - f. from the plurality of amplitude values, defining a  $t^*$  attribute by subtracting the natural log of the ratio of  $F_a(\text{low})$  to  $F_b(\text{low})$  from the natural log of the ratio of  $F_a(\text{high})$  to  $F_b(\text{high})$  to get a numerator and dividing the numerator by a denominator which comprises the defined high frequency less the defined low frequency; and
  - g. plotting the  $t^*$  attribute on a map and assigning a unique color to the  $t^*$  attribute.
9. (Amended) An apparatus adapted for detecting fractures in a fractured zone in an Earth formation, the apparatus comprising:
- a. a first means for operating on a plurality of received and recorded seismic traces, responsive to and representative of a plurality of acoustic waves propagating through the fractured zone and reflecting off a horizon in the formation, to define a first portion of the seismic traces corresponding to

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- a first window located above the fractured zone in the formation, and to define a second portion of the seismic traces corresponding to a second window located below the fractured zone in the formation;
- b. a second means to generate a first frequency spectrum associated with the first portion of the seismic traces corresponding to the first window and to generate a second frequency spectrum associated with the second portion of the seismic traces corresponding to the second window;
- c. a third means for superimposing the first frequency spectrum onto the second frequency spectrum thereby generating a superimposed frequency spectrum and defining from the superimposed frequency spectrum a low frequency and a high frequency;
- d. a fourth means for further defining, from the superimposed frequency spectrum, a plurality of amplitude values when the low frequency and the high frequency is defined, the plurality of amplitude values including an amplitude  $F_a(\text{high})$  of the first frequency spectrum at the defined high frequency, an amplitude  $F_a(\text{low})$  of the first frequency spectrum at the defined low frequency, an amplitude of the second frequency spectrum  $F_b(\text{high})$  at the defined high frequency, and an amplitude  $F_b(\text{low})$  of the second frequency spectrum at the defined low frequency;
- e. a fifth means for defining a  $t^*$  attribute from the plurality of amplitude values by subtracting the natural log of the ratio of  $F_a(\text{low})$  to  $F_b(\text{low})$  from the natural log of the ratio of  $F_a(\text{high})$  to  $F_b(\text{high})$  to get a numerator and dividing the numerator by a denominator which is the defined high frequency less the defined low frequency; and
- f. a sixth means for plotting the  $t^*$  attribute on a map and assigning a unique color to the  $t^*$  attribute.

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